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Conference Comments

THE British Weed Control Conference is held once every two years which is just about the length of time required to recover from it, to follow up the tit-bits with which one has had brief and transitory contact and to pick the bones out of the conglomerate mass of facts and figures.

In general the delegates' approach to the conference is similar to that followed for other conferences, the individual delegate concentrates on the subject which interests him most whilst using the other subjects as a background to his appreciation of developments in weed control as a whole. Some regard the conference as a holiday but one wonders whether they are only saying this to provide an excuse for not attending every session. Admittedly there is a chance to meet with old and new friends over dinner or a convivial pint but one could hardly think of a bitter November stroll on the cold hard pebble beach of a shuttered up seaside resort as a weekend joy ride or the works annual outing. Others have been known to regard the conference as an unwelcome chore to be finished with in the shortest possible time.

Whatever feelings are displayed, appreciative or unprintable, the conference to the vast majority of delegates is a highly condensed, concentrated and worthwhile business trip. The advantages for the scientists, technologists, agriculturalists, officials and the like, are obvious and need not be detailed for it is for their benefit that the conference is organised. However, the chances for commercial activity cannot be denied. Being a residential conference the opportunities for renewing old business contacts and making fresh ones are great, also keeping in touch with new developments is another way of keeping an eye on the progress of competitors.

Before decrying the entry of commercial aspects into a learned and scientific meeting it must be remembered that for the most part the keener the competition the more research and progress there will be, the ultimate beneficiary being the users of herbicides. At the conference no manufacturer can make a misleading statement as to the efficiency of his product, nor can he lightly gloss over any defect without some competitor, or independent scientist who has carried out his own trials, or grower who has used the product in practice, gleefully seizing on the opportunity to point out the discrepancy to all present. In such an environment the competetive effort is channelled in the right direction to the distinct advantage of farmer, grower, and other users of herbicides.

Continued on page 71

Photo courtesy of Cooper, McDougall & Robertson, Ltd.

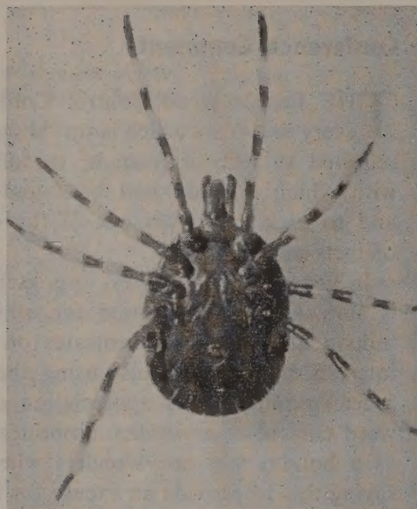

Fig. 1. Ventral view of a hard tick, Hyalomma spp.

TICKS, MITES AND DISEASES

By G. LAPAGE, M.D., MA., M.Sc.*

The following account is the first part of a three part article dealing with the acarina causing or transmitting human and animal diseases, and methods of control. This serves as a general introduction to the complete article.

Before we can understand fully the diseases with which ticks and mites are associated, and the methods that are used for their control we need to know what sort of animals they are, their habits, and methods of reproduction.

The Class Arachnida, to which ticks and mites belong, can be distinguished from other arthropods by the presence, in the adult stage, of four pairs of walking legs, the absence of a true head and therefore of antennae (feelers) and the possession of the type of mouth parts, namely chelicerae and pedipalps, shown in fig. 5. These mouth parts, like those of other arthropods, are modified in different arachnids in various ways in adaptation to the mode of feeding, those of the tick being adapted to sucking the blood of other animals. In general Arachnida are carnivorous and because they have small mouth openings, they either tear up their food or take it in liquid form from other animals or from plants.

Briefly it can be said that the ticks and mites are put in a separate order acarina because: (i) The distinctive mouth parts, are borne, on a horny plate called the *capitulum* (fig. 4). (ii) In addition, to the chelicerae and pedipalps, the acarina have, as fig. 5 shows, between these mouth parts, a single, median, horny projection, ventral to the mouth, called the *hypostome*, which bears on its under surface, recurved teeth and which is thrust into the wound made by the chelicerae in the skin of the animal, or the surface of the plant, on which the acarid is parasitic. Its function is to maintain a hold on the host animal or plant while the meal of blood or plant juices is being obtained. (iii) Apart from these characteristic mouth parts and the four pairs of walking legs, there are no other paired appendages on the body. (iv) The manner in which the segments of the body are fused is different from that found in other arachnids and frequently it is indistinct or all the segments have been fused to form one piece (fig. 3). (v) The life history differs from that of other arthropods and follows, in general, the plan of the life histories outlined later.

TICKS

Distinctive features of the ticks are that they are (i) larger, as a rule, than other Acarina, being usually big enough to be seen with the unaided eye, while mites are much smaller and may be microscopic in size; (ii) they are all parasitic and feed by piercing the skins of animals and sucking the blood or other body fluids of their hosts. There are, it is important to note, two families of ticks, the Argasidae, or *soft ticks*, and the Ixodidae, or *hard ticks*. The hard ticks (Ixodidae) have on their back a horny plate, called the *scutum* or shield

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Figs. 2 and 3 from Lapage G., Parasitic Animals.

Fig. 2 left. The mite Psoroptes communis *var.* ovis *ovigerous female.*

Fig. 3 right. Engorged female hard tick, Ixodes ricinus *laying eggs. Note lack of external segmentation.*

(fig. 4), while as can be seen in fig. 7 soft ticks (Argasidae) do not.

Another difference between hard and soft ticks is the fact that, whereas the capitulum and the mouth parts it bears project, in the hard ticks, in front of the tick and look like a head, in the soft ticks these organs are hidden in a groove on the ventral surface of the tick (fig. 7).

Hard ticks are found all over the world and species of three genera of them occur in Great Britain and are associated with the diseases of sheep, cattle and other animals. Soft ticks are commoner in the warmer parts of the world and only one species of them, parasitic only on the pipistrelle bat, occurs in the British Isles. Hard and soft ticks, moreover, differ in their method of feeding and this is very important when we are trying to control the diseases with which ticks are associated. Soft ticks suck the blood of their human and other hosts chiefly at night, and during the day lie hidden in crevices in human or animal dwellings or elsewhere. They take, moreover, frequent meals, moderate in quantity and after each meal of blood they lay a batch of about 100 eggs or fewer. Because the meals of blood are moderate, their bodies do not swell up after a feed as markedly as the bodies of female hard ticks do. The larvae, nymphs and adults of hard ticks each feed, on the other hand, only once, often during a period of only a few days, the meal taken being large, so that the body of the female tick swells up markedly when it is full of blood. Ticks thus full of blood are called engorged ticks, in contrast to unfed ticks, which are called flat ticks.

The other structural differences between hard and soft ticks, need not detain us here but wherever they are relevant, they will be explained below. Certain features of the life histories of ticks however, have important bearings on our understanding of the harm that ticks do and on the methods that are used for their control. Let us take, as our example of the life histories of ticks, the life history of the castor bean tick, *Ixodes ricinus*, which is parasitic on sheep, cattle and other animals in this and other countries of the world.

Life history

The mating of the castor bean tick takes place usually in this country in April or May, while the male and female are on the host. The male, after mating, usually dies; but the female, gorged with the host's blood, drops off the host on to the ground, and seeks a sheltered place in which to lay her eggs, or she may burrow in the ground to do this. Before she begins to lay eggs, however, she usually rests for four to eight weeks. The process of egg-laying is markedly influenced by the temperature and may be delayed by cold or too much light. The rate of egg-laying varies, but it has been estimated that the female castor bean tick may, under favourable conditions, lay one egg every twelve minutes, the total number of eggs laid being anything from 500 to 2,000. Some species of hard ticks may, however, lay as many as 18,000 eggs, a provision, no doubt, against the risks that their offspring have to run. The soft ticks, lay fewer eggs; they are numbered in hundreds rather than thousands. A point of practical importance is the fact that the female hard tick dies after laying her eggs whereas the female soft tick, after laying fewer eggs after each of her many meals, lives on to continue whatever harm she does.

The subsequent events in the life history are much the same in both soft and hard ticks. If we revert to our example, the castor bean tick, we find that the life history is divided into three stages subsequent to the

egg, called the larva (seed-tick), nymph and adult respectively. The development of the larva in the egg is complete when the egg is laid in April or May, and, provided that climatic conditions are favourable, from the end of August until October, the larvae, or seed ticks, will be emerging from eggs laid in crevices in the soil or other sheltered places, and this hatching out of seed ticks may go on, according to climatic conditions, for two to thirty-six weeks.

Three legged larvae

The larva (fig. 6), which is about the size of a pin's head, has only three, not four, pairs of legs. It may, therefore, be thought to be an insect, it may, for example, be confused with a wingless louse, but it can be easily distinguished from insects by its arachnid mouth parts and its lack of antennae. The larva of the tick does not become parasitic during the year in which it is born, but remains inactive during the winter in sheltered places in the herbage and, during the following spring, climbs up the blades of grass or other herbage and waits there for the passage of a suitable host. When a suitable host comes by the larva gets hold of it with claws on its walking legs and thrusting its mouth parts into the host's skin, it sucks the host's blood for three to six days or so. It then drops off, fully-fed, into the herbage again, where during the summer, it moults its skin and becomes the second stage or nymph.

Nymph

The nymph, differs from the larva in having four pairs of walking legs. It is, in fact, essentially an immature adult. It behaves pretty much as the larva did, remaining quiescent through the late autumn and winter and climbing, during the following spring, the herbage plants and waiting there until a suitable host comes by. It then attaches itself to the host, sucks its blood for three to four days and then drops off to take shelter in the herbage, where, during the summer, it moults its skin and becomes either an adult male or an adult female tick. The adults then remain quiescent till the following spring, when they, in their turn, climb up the herbage plants and wait for a host to appear. They then feed upon this for five to fourteen days before mating.

Fig. 4 I. ricinus, 8 legged nymph. Dorsal view showing scutum on the left; ventral view on the right.

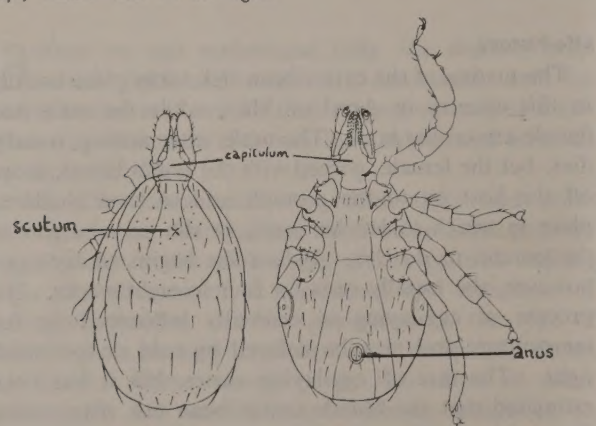


Fig. 5 Capitulum and mouth parts of the hard tick I. ricinus (female).

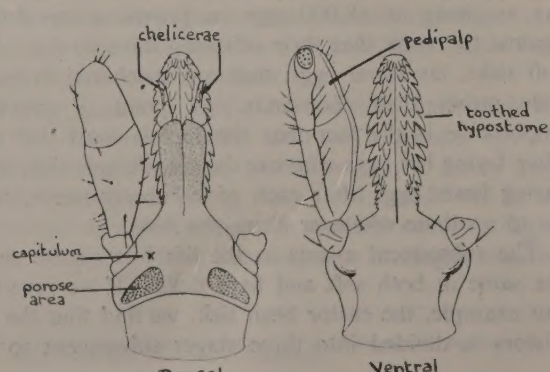


Fig. 6 Six legged larvae or seed tick of I. ricinus. Dorsal view on the right showing scutum, ventral view on left.

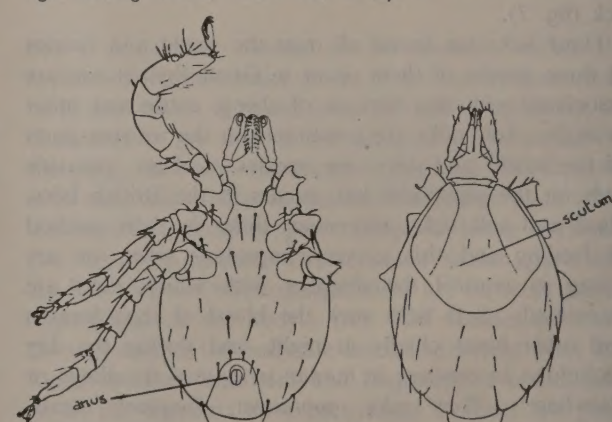
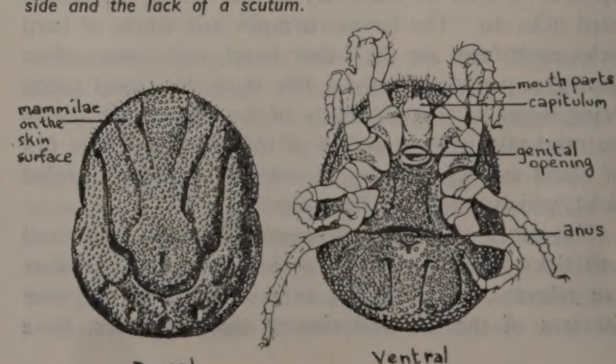


Fig. 7 The soft tick Ornithodoros moubata. Note the capitulum and mouth parts between the first pair of legs not visible on the dorsal side and the lack of a scutum.



The castor bean tick thus normally requires, in the climate of Great Britain at any rate, a full three years to complete its life history, the larva, nymph and adult each requiring one year. It will be realised, too, that all these stages of the life history are, for the greater part of the year, quiescent in the herbage and that they suck the blood of their hosts for no more than a few days each year, usually in the spring. There are however, in Cumberland, Wales, western England and Ireland, in addition to the normal spring-feeding castor bean ticks, races of them which feed on their hosts in the autumn, and not in the spring. In these parts of Britain, therefore, and perhaps elsewhere also, hosts may be attacked in the autumn as well as in the spring. Indeed, the various stages of the life history are so sensitive to climatic and other conditions in their environment, among which the presence of adequate moisture is important, that it may happen that individual larvae, nymphs or adults ticks may, for various reasons, miss the annual meal of blood in the spring or autumn and may therefore be hungry enough to attack hosts at other times of the year.

The numbers of castor bean ticks which may attach themselves to any one host may be considerable, and it must be remembered that a life history like this, means that, during any one spring, a sheep or cow may be infested with stages of the life history of this species of tick extending over three years and may bear clusters of these, all of which may be sucking, if only for a few days in each year, appreciable amounts of blood; even when the life history of a tick does not take as long as that of *Ixodes ricinus* does in Britain, the same three stages of it may all be sucking blood from the host at the same time.

Impact of life history on control measures

We have here, however, to remember another feature of the life histories of hard ticks. The three stages of some species of them, of which *Ixodes ricinus* just described is an example, each feed on a separate individual host animal. For each life history, therefore, three hosts are required and ticks with life histories of this kind are called *three-host ticks*. Other species, however, of which *Rhipicephalus evertsi* is an example, require only two individual animals as hosts. The larvae seek and feed on one of these and, instead of dropping off it to the ground, moult and become nymphs which also feed on the first host. The nymphs then drop off and moult on the ground to become adult ticks, which seek and feed on the second host animal. Ticks which do this are called *two-host ticks*. Yet other species, of which the South African blue tick, *Boophilus decoloratus*, is an example, require only one individual host animal. The larva, that is to say, feeds on this host and moults on it to become the nymph and then, while it is still on the same individual host, becomes the adult tick. Ticks of this type are called *one-host ticks*.

This distinction between one-host, two-host and three-host ticks is clearly important from the point of view of control. Control of a one-host tick, which passes through all the three stages of its life history on the same individual host animal will be easier because successful treatment of the host animal will destroy all the stages of the tick.* When, however, we consider the transmission of diseases by one-host, two-host and three-host ticks, we find that the causes of some of these diseases can be passed from the adult tick to the eggs, and from these to the larvae, and in some instances from these to the nymphs, or even on to the adults, so that all these stages of the tick can transmit the disease. The causes of some diseases are, on the other hand, not transmitted to all the stages of the ticks concerned, but only to some of them therefore it is important to know which of the stages can transmit the disease and which cannot and also whether the tick is a one-host, two-host or three-host tick.

MITES

The mites (fig. 2) include a large number of species many of which are harmless to both other animals and to plants. Some of them on the other hand, are serious pests of horticultural and agricultural crops and to various kinds of stored products. Others—the ones to be considered in these articles—are parasitic on man and other animals and on plants and either cause direct injury to these hosts or transmit to them the causes of serious diseases. Most of the mites are smaller than the ticks and many are microscopic in size. Their structure varies so much that it cannot be discussed in detail here, but it will, wherever it is related to injury or disease caused, be further discussed below. The life histories of mites are in general similar to those of the ticks, except that a second, or even a third, nymphal stage may be introduced. In the life history of the mite which causes human scabies, for example the six-legged larva is followed by an eight-legged stage called the first nymph and this moults to form what is called a pubescent male or female, a stage that is to say, which is virtually either an adult male or female, but is not yet sexually active. When it later becomes so, the pubescent female develops eggs and is called the egg-bearing (ovigerous) female and her eggs are then fertilised by the sexually-mature male developed from the pubescent male.

Figs. 4, 5, 6 and 7 from Nuttall, G. H. F., Warburton, C., Cooper, W. F. and Robinson L. E. (1908). Ticks, a Monograph of the Ixodoidae. Cambridge University Press.

* In practice *Boophilus* has proved very difficult to control because of its ability to develop resistance to Arsenic, BHC, dieldrin and other insecticides. The influence of resistance on control measures will be discussed by the author in the concluding part of this article which will be published by the author in our February issue.

CHLORINATED NAPHTHALENES

Chlorinated naphthalenes have been widely used in wood protection for nearly half a century. This article—the third in a series on organic solvent wood preservation—discusses their application and limitations.

By NORMAN HICKIN, B.Sc., Ph.D., F.R.E.S.*

It says much for the use of chlorinated naphthalene in *in situ* wood preservatives that—after more than forty years of use, they are still widely employed for this purpose. It is of considerable interest that the companies that still use them, are indeed companies that are at the same time the longest established and those responsible for a large part of the development work on formulation. The importance of the chlorinated naphthalenes, therefore, in this widely-expanding and important modern industry is unquestionable. They have played, and are playing, a distinct part in the preservation of the woodwork in buildings, and the question is, for how long will they continue to do so.

Production

Chlorinated naphthalene is manufactured by the chlorination (the simple addition of chlorine gas) of hot naphthalene. Time and temperature will, to a large extent, determine the constitution of the final product, which may vary in its chemical and physical properties within wide limits. The degree of purification is, in addition, a complicating factor with regard to the physical properties of this class of substance. However, wood preservative manufacturers who use chlorinated naphthalene in their products, at least in the United Kingdom and America, purchase standardised grade of the material from the chemical suppliers. These are supplied under brand names, with an accompanying specification. "Halowax" is a brand name, formerly used by Union Carbide, and now used for products manufactured and marketed by Koppers Inc., and "Seekay" Wax is the brand name for a short range of chlorinated naphthalenes manufactured by I.C.I. Ltd., in the United Kingdom.

In Germany, the largest manufacturing concern using chlorinated naphthalene carry out the chlorination process in their own works and it is therefore under their own control. The naphthalene arrives at the works in specially heated railway trucks, and the chlorine in steel cylinders. The products manufactured by this company probably contain a mixture of mono and dichloronaphthalene, which are liquid at ordinary temperatures.

The chlorinated naphthalene in the form of "Seekay" Wax, is, as its name implies, a waxy solid, but has a melting point of between 68°C. and 135°C., which is very much higher than the usual waxes of plant or animal origin. The odour, at least in the purified grades, is slight or there may be practically none.

In the United Kingdom the usual pure grade of "Seekay" Wax used by wood preservative manufacturers is a yellowish-white waxy solid of specific gravity of 1.588 at 20°/20°C. (by displacement in alcohol). The setting point is 92.4°C. The total chlorine content is approximately 50%, so that we should examine what

TABLE I

The calculated theoretical chlorine content of chloronaphthalene

Name	Formula	% Theoretical Chlorine
Naphthalene	$C_{10}H_8$	NIL
Monochloronaphthalene	$C_{10}H_7Cl$	21.85
Dichloronaphthalene	$C_{10}H_6Cl_2$	36.2
Trichloronaphthalene	$C_{10}H_5Cl_3$	46.0
Tetrachloronaphthalene	$C_{10}H_4Cl_4$	53.4
Pentachloronaphthalene	$C_{10}H_3Cl_5$	59.1
Hexachloronaphthalene	$C_{10}H_2Cl_6$	63.6
Heptachloronaphthalene	$C_{10}H\ Cl_7$	67.4
Octachloronaphthalene	$C_{10}\ Cl_8$	70.3

* *Scientific Director, The Rentokil Group.*

is theoretically possible in this regard. I am indebted to my colleague Mr. F. K. Deutsch for the preparation of table 1.

Obviously "Seekay" wax is a complex mixture of some of the products shown above. There are eleven isomers of tetrachloronaphthalene and fifteen isomers of trichloronaphthalene, theoretically immediately obvious although due to steric hinderance and other factors it is possible that some of these isomers do not normally occur, but it is possible that some of the isomers may exhibit further forms of spatial stereoisomerim.

Presence of hydrolysable chlorine

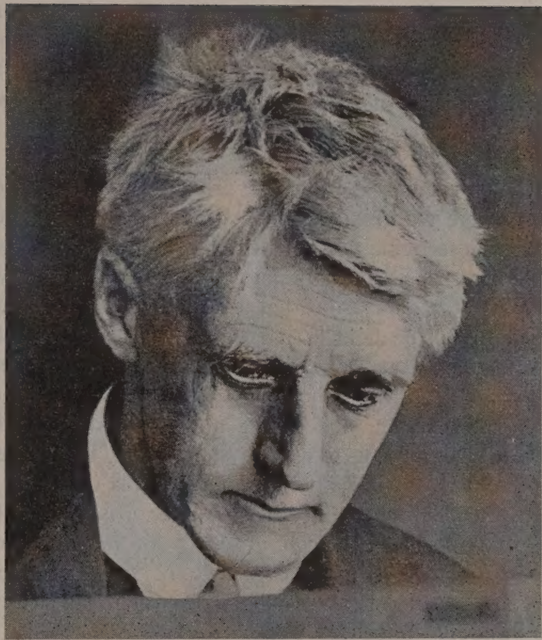
A point of importance concerning the chemical constitution of chlorinated naphthalenes concerns any hydrolysable chlorine which may be present. This must be the very minimum as it could be foreseen that if this was in excess, then corrosion of metal containers might result, unless otherwise inhibited. In addition chemical degradation of the wood is possible due to the production of hydrochloric acid. Matter insoluble in the organic solvents, likely to be used in formulations must also, of course, be the very minimum. These two points should be covered in the specification agreed between manufacturers and user.

The solubility of the chlorinated naphthalenes in the solvents likely to be employed is good, but most formulating processess would require the solvent to be heated for rapid solution. Although, on the one hand the material is stable and very resistant to acids and alkalis (chlorinated naphthalenes are indeed sometimes employed as a coating material for rendering textiles or wood, acid and alkali resistant) and chlorine is not liberated at relatively low temperatures, yet on the other hand temperatures in excess of 10 - 15°C. higher than the melting point of the material, should never be used, as otherwise toxic fumes may be produced. In the mixing department the solution of the chlorinated naphthalene must be carried out under conditions of good ventilation with exhaust hoods completely covering the mixing vessels.

TABLE II

Solubility of "Seekay" Wax R93 at 17°C

Solvent	Grams of wax per 100 grms of solvent (approx. value.)
Benzene	170
Trichlorethylene	125
Ethyl ether	110
Monochloronaphthalene	110
Toluene	108
Monochlorobenzene	94
Carbon tetrachloride	83
Turpentine	64
White Spirit (b.p. 157-190°C)	35
Petrol	25
Ethyl alcohol	5
Methylated spirit	1.5
Methyl alcohol	0.5
Water	Nil



Professor Harold Maxwell Lefroy, M.A., F.E.S.
Entomologist,
January 20th 1877 — October 10th 1925

Historical

The U.S. Bureau of Entomology were apparently the first to experiment against wood destroying insects with chlorinated naphthalene. Krofoid stated that this was in 1913 in Panama, when "Halowax" was employed. In 1921 a patent was taken out by the Röchlingsche Eisen und Stahlwerke for wood preservatives made from chlorinated naphthalenes, but in 1923 the material was marketed by Consolidierte Alkaliwerke who had purchased the rights. Shortly after this, the manufacture of fluids containing chlorinated naphthalenes for controlling wood-boring insects began in the United Kingdom. Maxwell Lefroy who had previously spent many years as Imperial Entomologist in India, and who then held the chair of Economic Entomology at the Imperial College of Science, acted as consultant entomologist to the architect advising on the restoration of Westminster Hall. Death watch beetle was found to be doing extensive damage to the hammer-beam roof and Lefroy recommended the use (amongst other materials) of chlorinated naphthalene as a long-acting insecticide.

At least two companies who had their origins as manufacturers of *in situ* wood preservatives at that time, still continue to use this material today, although to a higher degree of chlorination than at first employed.

Biological significance

When we come to examine, critically, the published work where chlorinated naphthalenes have been tested for their insecticide and fungicidal efficiency, employing test organisms likely to be involved in wood decay, we are led to the conclusion that such work is very scarce. It can rightly be held as a criticism that much of the experimental work done on this material and, indeed, on many others, has either not been published at all, or the work has been done using non-standard methods. Perhaps the present moves to standardise British test methods will do something to remove this criticism in the future. Another difficulty, however, arises from the fact that most commercial products for *in situ* wood preservation are a mixture of two or more chemical materials selected for the manner in which the insecticides and/or fungicides work.

To elaborate this further, many *in situ* wood preservatives contain a number of active ingredients for action against wood-boring insects, one acting as a fumigant, another as a contact insecticide, and another as a stomach poison. Manufacturers differ as to the importance placed on each of these insect-killing methods. The fumigant is more important during the early stages of application, then in the middle period the contact insecticide would be more important, and lastly the stomach insecticide would have the long-lasting effect which is desired. Then, again, another complication arises on account of the differing susceptibilities of the various wood-boring insects to these different methods by which the chemical materials exert their insecticidal action. As an example, *Hylotrupes bajulus* is much more susceptible to fumigant action than *Anobium punctatum*. Which of the four different life stages is the material going to affect ? Manufacturers normally use oil bases of known high wood penetration, so that the insecticidal ingredients are carried as deeply as possible into the wood. This would leave very little insecticide on the surface to act upon the adult beetles, walking on the surface selecting a site for egg-laying.

Previous tests

Anything like comparable tests appear only to have been published in connection with the American "Halowax", (trichloronaphthalene) and the German group of products marketed under the trade name "Xylamon", and containing mono and dichloronaphthalene. So that fumigant action is likely to be more pronounced in the latter, than in the case of the less volatile trichloronaphthalene

In 1942 Schulze and Becker carried out a series of tests with "Xylamon" in which the concentrations were determined to produce 100% mortality in larvae of *Anobium punctatum* and *Hylotrupes bajulus* and tested against creosote oil. These results are given in Table III.

TABLE III

Toxic limits in kg/m³ of "Xylamon" and creosote oil against larvae of Anobium and Hylotrupes.

Preservative	Absorption causing a death rate of 100% (kg/m³)			
	Anobium		*Hylotrupes*	
	4 wks	12 wks	4 wks	12 wks.
Creosote oil	60-110	33-54	14-32	14-32
Xylamon - LX - colourless	18-29	6-13	7-13	5.5-7.0
Xylamon - LX - nature	33-75	11-17	11-21	4.8-8.6

In the same year authors reported on the fumigant effect of "Xylamon" and found it to be better than creosote oil. The good fumigant effect of "Xylamon", however, had been shown as far back as 1932 by Escherich who reported that *Hylotrupes bajulus* larvae lying at a depth of 4 cms. in the sapwood of a telegraph pole were all killed by brushing the surface. Eckstein however, did not get a complete kill of larvae even at 2.3 kg per square metre.

In 1949, in the annual report of the Council of Scientific and Industrial Research in Australia, it was stated that the insecticidal activity of chlorinated naphthalenes increased with increase in the number of chlorine atoms. So that it would be expected that the tri- and polychloronaphthalenes would be more satisfactory than the mono- and di-chloronaphthalenes, but many other considerations have to be borne in mind—not least human toxicity. Increase in the number of chlorine atoms, appears very likely to increase the toxicity of the material to human beings, but what appears not to have been published, and which would be very desirable, would be work to show the correlation between the amount of higher chlorinated material

TABLE IV

Preservative	Test Ground	Average absorption lb/cu ft.	Condition of specimens		
			Good %	Attacked %	Destroyed %
Halowax	Panama	19.1	14.3	14.3	71.4
	Australia	19.8	—	14.3	85.7
	Hawaii	20.7	14.3	14.3	71.4
	S. Africa	21.1	—	66.7	33.3
Creosote Oil	Panama	13.3	8.3	58.4	33.3
	Australia	13.1	33 3	50.0	16.7
	Hawaii	13.2	—	66.7	33.3
	S. Africa.	13.3	—	72.8	27.2

(referable to insecticidal properties) to the lower chlorinated material.

With regard to tests against termites the work of Hunt and Snyder using "Halowax" is summarised in Table IV given below, again comparable tests were carried out using creosote oil. These were stake tests carried out in the various parts of the world as given in the table.

Tests in New Zealand

Finally attention should be drawn to the work of Kelsey in New Zealand. This work involves two test insects, *Anobium punctatum* and a New Zealand native termite *Kalotermes brouni* Frogg. There are a number of references to a wood preservative containing chlorinated naphthalene in this paper. They refer to Rentokil, a proprietary brand of wood preservative used in the United Kingdom for *in situ* wood preservation. Through a misunderstanding Kelsey presumed this product contained only chlorinated naphthalene as the active ingredient, and this is not the case. In these larval transfer tests using *Anobium* larvae all were dead after two and a half months, with zinc chloride only 70% were dead after eight months. As might be expected, the figures for kerosene and turpentine mixture, paradichlorobenzene and ortho-dichlorobenzene showed that they were excellent for killing larvae. They did not exercise a reasonably permanent control and became progressively less effective as the treated blocks were seasoned. Kelsey also carried out a number of tests for applying preservatives to pieces of wood infested by larvae of *Anobium* and he gives a list giving the average percentage mortalities caused by the third and fourth coatings for the three surfaces as follows :

Chlorinated naphthalene	96.43%
Pentachlorphenol K.1	88.33%
Pentachlorphenol K.2	85.47%
Zinc naphthenate	80.31%

He also states that, *inter alia*, one coat of chlorinated naphthalene was almost equal to two coats of pentachlorphenols K.1 and K.2 and better than two coats of zinc naphthenate.

Conclusions

1. Chlorinated naphthalene is a generic term which included a wide range of chemical products from oily liquids to wax-like solids and with great variation in chlorine content.
2. They are used in compound formulae for *in situ* wood preservation more widely than perhaps generally appreciated.
3. They are thought to have good insecticidal properties, to act as a stomach insecticide, and to have long-lasting properties.
4. The toxic hazards must be watched closely both in manufacture of the wood preservative and in package labelling.

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Note : This list is a selection only.

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Conference comments (*cont. from p.59*)

However, the increase in tempo of the development of new herbicides and techniques to counteract the deficiencies in established methods widens the gap between the knowledge of the research worker and that of the farmer. This gap must be decreased by improvements in advice and education. The scientists and middle men such as advisory officials and agricultural merchants, must learn to translate new knowledge into the language of the grower who in his turn must acquire the will to learn. The "know it all" and "what was good enough for dad is good enough for me" attitudes which are still prevalent in the agricultural industry must be abandoned if agriculture is to progress. As P. H. Brown said, "The grower must be more liberal in outlook, accept new ideas in place of current practices and above all cultivate a precision outlook."

Photo: Fisons Pest Control

Selective weed control in maize with simazine, comparing the poor growth of maize in the untreated section (left) with the sprayed area where the maize plants are normal.

TRIAZINES AS SELECTIVE HERBICIDES

By Drs. A. GAST and H. GROB*

THE farmer has at his disposal a large number of herbicides representing a wide range of different chemicals. Only a few of these substances possess a true physiological selectivity, most of them having a relatively narrow safety margin. It is, however, possible to obtain an optimal herbicidal action on weeds and an insignificant phytotoxic effect on the crop by making use of correct timing, carefully chosen dosage rates, and by application during favourable meteorological conditions. This type of selectivity could be called physical selectivity as compared with true physiological selectivity.

Examples of both these types of herbicidal selectivity are given by a number of triazine compounds of which simazine, atrazine, and propazine are at present of major interest. Maize happens to possess the type of selectivity that can be explained by physiological processes. According to the work of Roth,[2] who has particularly studied the decomposition of simazine, maize is able to metabolize the simazine absorbed by the roots and translocated in the plant; the decomposition is achieved within a short period and at every stage of growth, i.e. from germination to the fully grown plant. Simazine damage to maize could only be observed in a few exceptional cases, due to gross overdosage or after disturbing the break-down process by mechanical agents such as hail or snails.

The mode of action of propazine on sorghum (*Sorghum durra*) may also be considered as an example of true physiological selectivity as this crop resists even extremely high dosage rates of propazine.

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Except for maize and sorghum this wide safety margin is not present in the other fields of application of these three triazine compounds. The limiting factors are the susceptibility of the crops and the behaviour of the herbicides in the soil particularly with regard to leaching properties, adsorption and the like.

Table 1 gives a summary of the results obtained so far with the three triazines as selective herbicides in various crops.

Simazine and Atrazine as Selective Herbicides

(a) *Application on Maize*

Table 1 shows that maize (and, with propazine, kaffir corn) is an exception amongst all tested crops. As already mentioned, maize is able to metabolize the absorbed triazine within a short time, changing the herbicide into innocuous compounds. Maize treated with atrazine in post-emergence applications gave the analytical results as shown in Table 4 (the authors are indebted to Dr. W. Roth for results of the chemical analyses).

Only simazine and atrazine, amongst the three triazines, are recommended for application on maize fields; viz. simazine as a pre-emergence herbicide (treatment immediately after sowing) and atrazine as a pre-emergence and post-emergence herbicide (treatment after emergence). Propazine has an extremely long residual action and more difficulties may be encountered with regard to 'residue carry-over' effects than in the case of simazine or atrazine particularly after application of relatively high dosage rates. In some respects simazine and atrazine differ considerably in their action.

Simazine acts chiefly as a pre-emergence herbicide and should be applied before or immediately after the sowing

Table 1

Use of triazines as selective herbicides in various crops

Product	Application with very wide safety margin	Application with wide safety margin	Application with narrow safety margin
Simazine	maize	grape-vine, fruit-trees (pip fruit), asparagus, red and black currants, sugar-cane, pineapple, citrus forest trees.	cereals, strawberries forest nurseries
Atrazine	maize	grape-vine, fruit-trees (pip fruit), asparagus, sugar-cane.	
Propazine	maize, kaffir corn	carrots, fennel, celery.	

Table 2

Influence of herbicidal treatment on maize. Tests of 1959

Locality: Pfeffingen (Switzerland)*: weed flora—chiefly perennials; crop—forage maize.*
Massongex (Switzerland)*: weed flora—chiefly annuals; crop—grain maize*

Herbicide	lbs. a.i. per acre	time of application	% increase in yield as compared with untreated plots.	
			Pfeffingen	*Massongex*
Simazine	1 lb.	pre emergence	+ 230	– 2
	2 lbs.	pre ,,	+ 185	+ 7
	5 lbs.	pre ,,	+ 345	+ 11
Atrazine	1 lb.	pre ,,	+ 245	+ 151
	2 lbs.	pre ,,	+ 275	+ 15
	5 lbs.	pre ,,	+ 390	+ 22
	1 lb.	post ,,	+ 230	+ 26
	2 lbs.	post ,,	+ 240	+ 1
	5 lbs.	post ,,	+ 285	+ 6

Table 3

Analysis of the fresh green maize plants

Product	lbs. a.i. per acre	Time of application	Fresh weight in % of untreated	Fresh green plants, in % as compared with check plots.			
				dry weight	*ash*	*raw proteins*	*non-protein extract*
Simazine	1 lb.	pre emergence	+ 90	+ 6	– 8	+ 18	+ 8
	2 lbs.	pre emergence	+ 92	+ 8	– 8	+ 45	+ 11
	5 lbs.	pre ,,	+ 128	+ 10	± 0	+ 54	+ 11
Atrazine	1 lb.	pre ,,	+ 77	+ 1	– 8	+ 18	+ 4
	2 lbs.	pre ,,	+ 99	+ 5	– 8	+ 27	+ 8
	5 lbs.	pre ,,	+ 145	+ 6	– 8	+ 27	+ 7
Atrazine	1 lb.	post ,,	+ 72	– 5	– 8	+ 27	– 4
	2 lbs.	post ,,	+ 71	+ 1	– 8	+ 36	+ 4
	5 lbs.	post ,,	+ 106	– 1	– 8	+ 27	+ 1

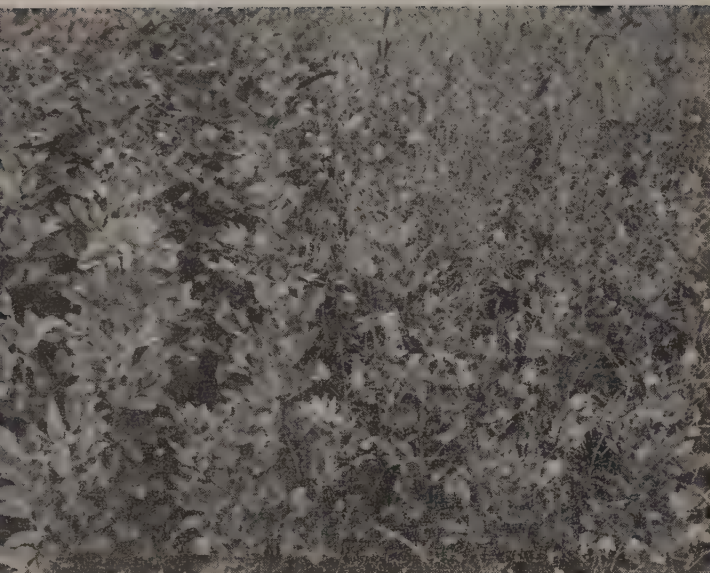

Photo: Fisons Pest Control

Pre-emergent weed control with simazine in field beans

of maize. Its effect is best when it can reach as rapidly as possible the zone of germination of annual weeds and the root-zone of perennials. The chemical being principally washed into the root-zone by water, the success of a treatment depends partly on rain falling immediately after the application and partly on the permeability of the soil. Soils rich in organic matter retain the substance to a larger extent than sandy soils. In regions of low rainfall the control of perennial weeds such as couch grass (*Agropyron repens*), creeping thistle (*Cirsium arvense*) and bindweed (*Convolvulus arvensis*) will usually be found insufficient but in most cases the amount of precipitation will be sufficient to control annual weed species.

Atrazine is suited for pre- and post-emergence treatments. It is absorbed by aerial parts of the plant as well as by the roots due to its higher solubility in water. This higher solubility also endows atrazine with a quicker initial effect than simazine. Atrazine is also less dependent on meteorological factors. These additional properties allow atrazine to be applied in regions of low rainfall. A disadvantage of atrazine as post-emergence herbicide may be its inadequate action against various species of millets.

The dosage rate recommended for simazine and atrazine depends on the weed flora to be controlled. When annuals are predominant, the dosage lies between 0.75 and 2.0 lbs a.i. per acre, the lower dosage being indicated for northern regions where late-germinating weeds are rare and where the weed species are very susceptible to simazine or atrazine (e.g. Germany, Netherlands, Belgium). In southern countries the dosage rate will have to be increased to about 2lbs. a.i. per acre, in order to control late-germinating plants and the rather resistant species encountered in these climates (*Amaranthus* and millets). Fields which are infested with perennials (e.g. creeping thistle, couch grass, bindweed, coltsfoot, creeping buttercup, etc.) have to be treated with higher dosage rates (up to 5lbs. a.i. per acre).

The elimination of weed competition has a beneficial effect on the yield of the crop both with regard to quantity (Table 2) as well as quality (Table 3). The increase in yield is mainly attributed to the successful elimination of the competition by perennial weeds (Table 2, Pfeffingen). The results obtained in fields almost exclusively infested with annuals are less conspicuous since they do not inhibit the development of the crop as much as perennial weeds (Table 2, Massongex).

Table 3 gives the results obtained from analyses of fresh green plants collected on the plots at Pfeffingen. The data have been kindly supplied by the Swiss Federal Experiment Station, Liebefeld.

The maize yield, as a result of the herbicidal treatment with simazine and atrazine, shows a very definite quantitative increase. Hydrocarbons (non-protein extract) are distinctly higher in the pre-emergence plots than in the untreated plots; the same applies to the raw protein contents. The fact that the post-emergence application increases only slightly the hydrocarbon contents can be explained by the late intervention of the herbicide; the crop was unable to compensate the initial weed competition.

Subsequent crops: Simazine and atrazine have, in higher dosage rates, a long residual action. This property is most welcome for the weeding of uncultivated land such as railway tracks, roads, industrial sites or of perennial crops such as vine-yards, fruit-tree orchards, asparagus, etc., but it is linked with important problems in crop rotation.

Much experience has been gathered already with regard to crop rotation and simazine treatments; for the more recently developed atrazine, the results of the latest tests should be awaited before the problem can be considered as solved. The disappearance of chlorotriazines in the soil will be dealt with in the part on viticulture (page 71, Table 6). In certain cases where weed control can be achieved in maize with low dosage rates (0.75 to 2lbs. a.i. per acre) it is possible to sow after the harvest (i.e. 4-5 months after the herbicidal treatment) any type of autumn crop without damage. Since simazine is chiefly retained by the top layers of the soil, deep ploughing as a preparatory measure represents an additional security for the seed. The situation is more difficult when applying the higher dosage rates (e.g. 5lbs. a.i. per acre) generally required for the control of perennials such as couch grass, thistles, coltsfoot, etc.

The herbicidal treatments in heavily infested fields

should be performed strictly according to the special recommendations on crop rotation and on soil residue carry-over.

Following a simazine application in spring, autumn sown crops usually show some damage during winter with the exception of vetch and field bean. After application of high dosage rates it is advisable, therefore, to plan a winter fallow. Safe growing conditions for susceptible crops such as clover, mustard, rape, cereals, etc. are only guaranteed in the following spring, i.e. about one year after treatment.

These difficulties may generally be overcome in very heavily infested fields by treating in the autumn. Maize is then sown in the following spring and winter cereals may be cultivated after the maize has been harvested.

According to the results available at present the same safety measures should be taken with atrazine to protect subsequent crops.

One of the striking features in these tests on subsequent crops is the vigour and good condition of the crop in the treated plots when the herbicidal action has elapsed. The herbicidal treatment regularly initiates, as an after-effect, not only the elimination of nearly all the perennial weeds and the protracted absence of annuals, but also the optimal conditions for the healthy growth of the crop.

(*b*) *Application in Viticulture*

Considerable experience has been gained—from laboratory tests and from field trials in various countries,

TABLE 4

Atrazine residues in maize plants

Time after treatment	Atrazine in ppm
0 day (immediately after treatment)	157.0
1 day	139.0
2 days	21.0
6 days	5.7
10 days	1.1
3 weeks	0.1
1 month	0.1

TABLE 5

Grape production in vine plots. Fully and Leytron, 1955

Fully (Valais, Switzerland, variety: Chasselas, age: 10-15 years
Yearly treatment with simazine; dosage given in lbs. a.i. per acre

Simazine a.i. lbs/acre 1956	1957	1958	1959	Yields increase or decrease in % of untreated: *Weight*	*Degrees Oechsle*
10	10	10	10	+ 3.2	+ 2.5
5	5	5	5	+ 12.3	± 0
2	2	2	2	+ 7.5	± 0
—	—	—	10	+ 7.5	+ 2.5
—	—	—	5	+ 12.0	+ 3.4

Leytron (Valais, Switzerland), variety: Pinot gris, age: 10-15 years
Yearly treatment with simazine; dosage given in lbs. a.i. per acre

Simazine a.i. lbs./acre 1955	1956	1957	1958	1959	Yields increase or decrease in % of untreated: *Weight*	*Degrees Oechsle*
10	10	10	10	10	+ 47	+ 4
—	10	10	10	10	+ 2.2	+ 5
—	5	5	5	5	+ 11	+ 3
—	2	2	2	2	− 24	+ 2
—	—	—	—	10	+ 32	+ 4
—	—	—	—	5	− 5	+ 2
—	—	—	—	2	− 13	± 0

TABLE 6

Simazine determinations of soil samples from the vine test plots of Fully and Leytron (Valais, Switzerland). Analyses of 1958 and 1959

Fully:
Yearly treatment with simazine a.i. lbs. per acre, 1956-1959 10 lbs.

Depth of sampling in cm	ppm 1958	ppm 1959
0–5	1.775	4.1
6–10	0.436	4.25
11–15	0.10	0.9
16–20	0.08	0.39
21–25	0.095	0.23
26–30	0.065	0.12
31–40	<0.05	0.07
41–50	<0.05	0.03

Leytron:
Yearly treatment with simazine a.i. lbs. per acre. 1955-1959 10 lbs

Depth of sampling in cm	ppm 1958	ppm 1959
0–5	2.5	2.1
6–10	0.2	0.85
11–15	0.25	0.73
16–20	0.34	0.36
21–25	0.11	0.09
26–30	0.07	0.03
31–40	0.055	0.15
41–50	<0.05	0.06

on all types of soil, different climatic conditions and in the presence of a great variety of weed populations —on the possibilities of the application of triazine herbicides, particularley simazine, in viticulture.

Simazine is, especially in the temperate zone, the most effective weed-killer now available; bindweed (*Convolvulus arvensis*) is the only weed that presents a serious problem when it is used.

In warmer regions, however, the application of simazine is greatly limited by the presence of very resistant weed species such as *Cynodon dactylon*, *Sorghum halepence*, etc., but it can be used successfully in combiation with specific grasskillers.

Our own tests have shown that even after unusually high dosage rates over many years (10lbs. a.i. per acre each year since 1955) no damage was inflicted to vine plants. We know from laboratory tests that healthy vines are able to metabolize simazine. Gast [1] reported on this subject in a detailed paper where he atributes the loss of simazine to the following factors:

Adsorption of simazine on the surface of the soil particles,

Break-down of simazine resulting from the activity of micro-organisms,

Break-down of simazine resulting from the activity of higher plants.

In Switzerland considerable areas of the vine growing districts have been treated with simazine during the last two years. Only a few localised cases of damage were brought to our knowledge and these from young vine plants grown under unfavourable conditions. Newly planted vines showing symptoms of chlorosis are unable to metabolize simazine rapidly enough and are consequently more susceptible to this weedkiller.[1]

The determining factors for the suitability of a selective herbicide in viticulture are its effect on the yield and quality of the vine and its behaviour in the soil.

These problems were investigated in a special study the main results being summarized in Table 5.

It is concluded from these figures that the simazine treatments, even when repeated for several consecutive years at extremely high dosage rates have no detrimental effect on yield or on quality. The main weed species in the test of Leytron was bindweed which can only be reduced progressively over several years of simazine applications at rates of at least 5lbs. a.i. per acre. The figures given in Table 5 show that the increasing simazine dosage rates produce a better herbicidal action and in most cases a better yield; this is particularly noticable in the test started in 1959.

The application of simazine represents considerable progress in vine root stock nurseries, as it is impossible to control the invading weeds by mechanical means. Treatments of heavily infested nurseries with simazine resulted in a 5 to 6 fold increase in yield of root stock cuttings.

c) *Application on Other Crops*

The test results for maize fields and vineyards have been given in some detail because both these crops are very important and equally the application of a selective herbicide is linked with various fundamental problems. The same problems present themselves in the other fields of application of simazine and atrazine so that the discussion need not be extended to all. Many years of thorough testing in various countries proved that a number of crops tolerate simazine quite well: pip fruit trees, red currants, raspberries, asparagus, sugar-cane, citrus and pineapples, etc. Investigations were started some time ago and simazine shows considerable promise on banana, coffee, etc. The testing of simazine has been extended to cases of weed control where no satisfactory solution has been obtained so far, e.g. hormone-resistant grasses in cereals: corn-grass (*Apera spicaventi*), blackgrass (*Alopecurus myosuroides*) and wild oats (*Avena fatua*). In fact, all these grasses are more susceptible to simazine than cereals. A dosage rate of 750 grams a.i. per ha. is sufficient to control corn-grass and blackgrass, but great differences are observed in the simazine tolerence of different species of cereals, the time of the treatment being a further factor to be investigated. Barley and rye can stand dosage rates of 1.5 and 2.0 lbs. a.i. per acre, whereas winter wheat is damaged by more than 1lb. a.i. per acre. Large scale tests are being conducted at present with barley, wheat and rye and it will be necessary to await the results before a final verdict can be given as to the usefulness of such simazine treatments.

Tests were also performed in strawberries with varying results. In some parts of the USA it was possible to use simazine without endangering the crop, whereas the strawberry plant proved to be susceptible to simazine in most of our tests in Switzerland. These differences can be partly attributed to differences in meteorological conditions, partly to different types of soil; the time of application was also different (in the USA one treatment in autumn, shortly before the winter rest period, is sufficient, whereas in Switzerland only spring treatments are considered as a practical procedure). However, the main reason for this difference in susceptibility lies probably in the different varieties of strawberries. The USA variety, Marshall, was particularly tolerant and the European variety, Senga Sengana, stands higher dosage rates than the variety, Madam Moutot, generally grown in Switzerland.

Propazine as Seletive Herbicide

Propazine was the object of many years of testing as pre-emergence and post-emergence herbicide in carrots and other umbelliferous crops. Special attention was

given to the susceptibility of the different varieties and to the problem of subsequent crops which is most important for short-lived crops alternating in quick succession. The result of all the testing is the recommendation of a dosage rate of 0.5lbs. a.i. per acre in pre-emergence treatments. The herbicidal effect is sufficient for the control of annual weeds with the exception of millet and pigweed (*Amaranthus*). In soils rich in organic matter, however, the dosage rate should be 1lb. a.i. per acre because of the stronger absorption. According to the experience gathered so far these dosages can be applied to all tested varieties of carrots without damage, namely:-

Amsterdam	Gonsenheim	Perfection
Touchon	Wunderkugel	Chantenay
Guerande	Pariser Markt	Flakkeer
Nantaise	Bellot	Yellow of Palatinate
Huba	Berlicumer	

Residual action in the soil

It has been mentioned already that propazine has a considerable residual action. Similar to simazine (and to a certain extent atrazine) propazine is retained by the top layers of the soil. We studied the problem of subsequent crops with important vegetable and horticultural species: tomatoes, beans, beetroots, fennel, cress, cauliflower, kohlrabi, lettuce, endive, leek, strawberries, tulips, daisies, forget-me-nots, pansies, sweet williams, foxglove, lupins, etc. The critical dose provoking the first symptoms is 600 grams a.i. per ha. for lettuce with about 6 months between treatment and sowing. The safety margin can be considerably extended by ploughing deeply before sowing the new crop. Celery, fennel, and sorghum also proved to be tolerant to propazine.

According to tests carried out in the USA, kaffir corn (*Sorghum durra*) can stand much higher dosage rates of propazine than carrots in pre-emergence treatments.

Tests with new triazine compounds are being carried out at present; they show new herbicidal properties, selectivity and scope, compared with those known for simazine, atrazine, and propazine. It may be hoped, with some justification, that new fields of application will develop or that they will fill in such gaps as have been left by the triazines now available. It will, however, only be possible to answer all the questions related to the use of triazines as selective herbicides after some years of experimentation.

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MONEY FOR RESEARCH

According to the recently issued colonial research report* research related directly or indirectly to pest control appears to have received, relatively speaking, a considerable amount of financial support from Colonial Development and Welfare grants in the year 1959-60, in which grants totalling £2,370,261 were approved for 134 new research schemes and 82 supplementary schemes.

Of the gross allocation of Colonial Development and Welfare funds for research during 1959-60, 23.7% was for pesticides research, 7.1% for anti-locust research and 1.9% for tsetse and trypanosomiasis research. No doubt some of the 42.6% of the funds allocated for agricultural, animal health and forestry schemes will also be used for pest control research. One of the largest single grants approved during the year was the £313,032 for the Colonial Pesticides Research Unit, Arusha, Tanganyika.

New projects during the year included, in Britain, research on the preservation of malarial parasites, studies of the genetics of *Aedes aegypti*, and studies of tick-borne diseases, to be carried out at the London School of Hygiene and Tropical Medicine (with grants totalling £9,967); the provision of a "Colonial Pool of Pesticides Chemists" based at the Tropical Products Institute, London (grant of £10,380); and the appointment of an analytical chemist for stored products work at the Pest Infestation Laboratory, Slough, (grant of £5,055).

Of overseas projects £55,506 serves as a contribution towards the recurrent cost of the Wellcome Institute for Research on Foot and Mouth Disease, Kenya; £57,489 was made available for research on coffee berry disease, fauna and cereals in Kenya; in North Borneo agricultural research services and the establishment of agricultural research stations is aided by a grant of £254,625; and in British Honduras termite research will benefit with a grant of £11,775 and a grant of £33,350 will be used in a study of dermal leishmaniasis.

* *Colonial Research 1959-60, published by H.M.S.O. price 17s.*

Delegates Hear of new Trends in Pest Control

Like its predecessor the fifth British Weed Control Conference provided an unlimited wealth of information, facts, figures, criticism and comment. To many scientific and agricultural journalists the conference is a veritable utopia which allows one to develop almost any line of approach to almost any aspect of weed control. Almost any of the ten sessions or even any particular paper could—according to viewpoint—be regarded as the highlight.

Let us take a brief glimpse of some of the potential 'headline accounts'.

War on water weeds

Further Progress in aquatic weed control — Acrolein shows rapid kill of broad leafed weeds but application difficulties may limit its use to emergency conditions where rapid kill of vegetation is required.

Pellets prove popular — 2, 4-D pellets give excellent control of broad leafed species in near stagnant water. Slow release from pellets reduces danger, increases persistence. Danger to crops in the use of 2, 4-D pellets in irrigation channels.

Change of opinion on the mode of action of aquatic herbicides — New evidence that phenoxyacetic acid group is absorbed through leaves and stems, not through the roots.

Atrazine warrants further trials for the control of vegetation in marshy bottomed dykes.

Diquat deserves trials for aquatic weed control — Success in preliminary trial.

Emergent broadleaved weeds easily controlled with auxin herbicides.

Secondary consequences more important in aquatic weed control than in any other use of herbicides.

Herbicides in waterways produce no detrimental influence on the environment for fish — Further research on fish susceptibility required.

Horticulture

Should your interest extend to the use of herbicides in horticulture suitable phrases may well run as follows.

Simazine success in cane crops.— Several speakers testified to the excellent weed control obtained in raspberries, black currants, gooseberries and other fruit crops with simazine at 2 lbs./acre. Atrazine at 4 lbs./acre also gives promising results and may prove even more useful than simazine in drought conditions. Results in strawberries variable. The search for alternative herbicides to the triazines continues. At rates giving good weed control the monuron and other substituted ureas damage crops, further research is required. 2, 4-DES and propham may prove useful alternatives in some cases.

Weed control in ornamentals. — Need for basic information is evident. No general conclusions can be made due to insufficient knowledge of crop tolerance, and the effect of soil type, temperature, rainfall, etc., or the activity of herbicides applied to the soil. Early treatment with contact pre-emergence weed killers such as PCP and diquat proves useful for obtaining a weed free bed necessary for the successful use of residual herbicides. Within limits chlorpropham appears to be a useful pre-emergence herbicide for bulb crops, and appears to be more efficient when used in mixtures with fenuron and diuron. However, the period of weed control is not sufficiently extended and hoeing and hand weeding is still necessary especially on established bulb beds. In nurseries, established ornamentals and some roses simazine may be used safely. Propazine is recommended for further experimentation in conifers.

User's viewpoint

No reference to the use of herbicides in horticulture should be made without some mention of the paper *Weed Control in Horticultural Crops —Present and Future* by P. H. Brown, who from the user's angle pointed out some of the present deficiencies in this aspect of weed control. In a positive and frank account he stated that—

(1) The horticultural industry must for economic reasons, make even greater use of herbicides.

(2) The development of new selective herbicides and new forms such as granulated herbicides is called for as is the need for much fuller testing before release. The existing and future residual types must be investigated much more in regard to their persistence and risk.

(3) Coupled with the need for new materials is the need to develop equipment for their application in which respect band application would appear to be high on the priority list.

(4) Advice to the grower must be improved. The pre-requisite to this is much more factual knowledge concerning the performance and behaviour of herbicides under a wide variety of conditions, obtained from a much increased field experimentation programme covering the whole country.

(5) The grower must be more

liberal in outlook, accept new ideas in place of current practices and above all cultivate a *precision outlook*, for precision it must be in all matters connected with herbicides.

New materials

To those reporters wishing to keep up with the frontiers of knowledge session ten on new herbicides and techniques provided adequate material covering a new chemical, 2, 6-dichlorobenzonitrile (2, 6-DBN), new equipment and new formulations.

An alliterative headline may be as follows :—

Dual Discovery of DBN—British and Dutch firms have been carrying out independent tests on the herbicidal properties of 2, 6-DBN which shows a phytotoxicity unequalled in the herbicide field. The compound's outstanding biological feature is its very high toxicity to seeds and buds generally and it shows by virtue of this activity considerable promise for the control of a wide range of annual and perennial weeds including grasses and broad leaved species. Several important woody crops such as fruit and ornamentals, have shown considerable tolerance but otherwise 2, 6-DBN has no wide selectivity. 2, 6-DBN is extremely volatile at normal temperatures and hence possesses a short persistence. Since in practice it is most active when applied to the soil, the persistence largely determines herbicidal effect obtained and subsequent permissible freedom of cropping. The indications are that relative to such residual herbicides as simazine and substituted ureas, the short persistence of 2, 6-DBN indicates that land should be safe to crop within a few weeks or months of application depending on the method of use.

Incorporation of the chemical into the soil decreases the rate of loss by volatilisation four fold. Due to the low solubility of 2, 6-DBN the persistence can also be increased by overhead irrigation or rainfall. The use of granular formulations will again increase its residual properties.

These factors suggest that the first practical use of 2, 6-DBN will be in the maintainance of vegetation free ground between consecutive crops and further research will lead to other outlets.

Diquat

Speaking of the development of new outlets leads us to another paper in this section which may well have been entitled "Development of Diquat". As many will know diquat was recently marketed in this country as a potato haulm dessicant. As a dessicant it can also be useful for stripping machine harvested cotton, legume seed crops, and as a 'pre-burning' dessicant for use in fire breaks and sugar cane.

Its total contact herbicidal properties suggest that it may lend itself to the killing of 'trash' in bulb beds before lifting in late summer, and to its use in situation where top kill *but not* root kill is desired, i.e., on ditch banks where roots bind the soil and prevent erosion. There is also a possibility that it will be very valuable as an aquatic herbicide.

Wild oats

Of all the subjects discussed at the conference the one which will no doubt gain the greatest publicity will be the Control of Wild Oats with the two carbamates barban (Carbyne) and 2, 3-dichloroallyl di-isopropylthiol carbamate (Avadex). Surprisingly they have only one thing in common and that is they can give appreciable control of wild oat thus leading to high increases in yield.

When two new compounds both seeking to do the same task are announced almost simultaneously, first reaction is to compare the two to find out which is the better material. The battle of wits which ensued between the commercial protagonists of the two chemicals was most enjoyable. However, as each product has its limitations as well as advantages the choice of chemical will vary with the situation. For example barban is a post-emergence herbicide applied to weeds and crops whilst Avadex is applied pre-emergence to the soil. Timing of the application of barban is most critical. Application when the majority of the wild oat flush is in the 1-1½ leaf stage gives the highest increase in crop yield but curiously enough a greater reduction in wild oat numbers occurs when the application is delayed to cover the 1½-2½ leaf stage. It is recommended that spraying is carried out when the majority of wild oats are at the 1-2½ leaf stage. As all the wild oats will not develop at this time it is obvious that complete control will not be attained. Indeed the reduction in wild oat numbers never reached 80% and was generally in the 60-70% region or less, yet yield increases as high as 16 cwts./acre have been attained. Avadex on the other hand has given a consistant high degree of control—often in the 80%-95% range and occasionally higher. As it is a soil applied herbicide timing is not so critical but it could be expected to give the variable results often associated with this type of application (due to the effects of soil type, organic content, rainfall, etc.) yet the consistency of Avadex has been surprising. Avadex too has led to high increases in yields thus testifying to the competitive effect of the wild oat.

Although barban does not give as high degree of control of wild oat, with regard to numbers, as Avadex, the surviving wild oats are generally stunted and smaller than the crop and probably offer little competition to the crop and produce less viable seed. On the other hand although fewer wild oats survive the Avadex treatment the ones that do are vigorous and generally grow above the crop and produce a full complement of viable seed.

It must be remembered that both chemicals have been developed with a specific purpose in mind — the control of wild oat in cereals — and like many specific herbicides their use will be governed by many factors, such as the type of cereal crop (i.e., Proctor Barley is susceptible to barban and winter wheat is susceptible to barban at a certain stage, generally in March, though it can be safely sprayed at other times), cost, soil type, climatic conditions, and farm management (i.e., whether or not the cereals will be undersown). They will have to be used on a commercial basis for several years before the practical value of each can be properly assessed and compared. In addition it must not be forgotten that the seed of the wild oat is particularly resilient, being capable of lying dormant in deep soil for many years yet when it is brought to the surface layers by cultivation or other means it is able to germinate and produce a vigorous mature plant.

Comment

The above is just a brief guide to one or two of reports which may be given and further expounded yet even so there will be much left un-

mentioned. For example, the session on problems of advice and education, in which the views of the farmer, agricultural merchant and manufacturer were given, gains in importance with the increase in knowledge and the development of new herbicides and techniques. Will it be given much publicity?

The progress which is being made in the control of bracken (notably with 4-CPA) merits further mention than a few brief lines.

The popularity in North America of granular formulations of residual herbicides is increasing with the result that there is a growing interest into their possible use in this country. However, there are many problems to be solved, some connected with the difference between the weed problems and climatic conditions in the two countries, others revolving around the problems created by the effect of soil type on the efficiency of soil applied herbicides. Then again the most efficient equipment for the distribution of granular herbicides has yet to be found. Taking the argument further we have still some way to go to find the best methods of applying herbicides and this was reflected in two papers devoted to machines which will sow the seed, and apply the herbicides at the same time.

How many reports can argue the pro's and con's of this complex situation and yet manage to devote reasonable amount of space to other aspects of weed control?

Couch grass, *Agropyron repens*, remains one of the most vexing weed problems in agriculture but one wonders if two excellent papers on this weed by G. R. Sagar will receive any mention in the press despite the fact that his studies may be of considerable assistance towards resolving the problem of controlling this weed.

No doubt the Proceedings of the Conference will fill many gaps but until such time as they are published the press reports will have to suffice and we admit that the reports, like some of the herbicides we have been discussing, have their limitations.

Fisons release Carbyne to British farmers

Right hand side—ten wild oat plants taken from the untreated area. Left hand side—ten plants from tne area treated with Carbyne. These plants germinated after the application but even so they remain stunted with few viable seeds.

Hard on the heels of the 5th British Weed Control Conference Fisons Pest Control Ltd. announce that they are making Carbyne (American common name, barban, chemical name, 4-chloro-2-butynyl *N*-(3-chlorophenyl) carbamate) available to British farmers for the post emergence control of wild oat in all varieties of wheat and the varieties Earl, Rika, Spratt, Archer, Maythorpe, Carlesberg 11, Ingrid Pallas, Hillmarsh, Delta, Hafnia, Arvu Kenia, Hoisa II, Gateway, Abed Kenia, Gazelle, Valla, Herta, Vada, Ymer, Elsa, Swallow, Union Topper and Pioneer, of barley

The recommended dosage rate is 1 pint of Carbyne per acre applied in 10-20 gallons of water and although it is non toxic it is recommended that protective clothing is worn whilst handling the concentrate because it may cause skin irritation. Prolonged contact with the dilute solution should also be avoided for the same reason.

The cost for the chemical will be 70/- per acre and for this sum the farmer is likely to obtain yield increases ranging between 4 and 16 cwts./acre.

As was emphasised at the Weed Control Conference the timing of application is most critical and must be applied when the majority of wild oats are in the 1-2½ leaf stage. To ensure that spraying is carried out at the correct time technical representatives will call on farmers wishing to use Carbyne two and possibly three times. The first visit will be to inform the farmer of the capabilities of the product and the precautions necessary in its application, then if the farmer still wishes to go ahead a second visit is made when the wild oats are beginning to emerge, the objective being to assist the farmer in the identification of the weed and to advise on the correct timing. As many users as possible will be visited a third time in order to evaluate the results and to discuss any problems that have come to light.

The fact that these visits will be made appears to bear out the comment on our report on the Weed Control Conference that commercial usage will be necessary for the final evaluation of the new chemicals for the control of wild oats.

Juffy wheat in Northamptonshire. Right hand side—treated with Carbyne. Left hand side—untreated.

NEWS AND NOTES

British Ratin director in U.S.

E. M. Buchan, Joint Managing Director of the British Ratin Co. Ltd., recently addressing the National Pest Control Association Convention at Tulsa, U.S.A. On the evening of October 19th, he gave a brief outline of pest control law and practice in the United Kingdom, followed by historical notes on the development of the British Ratin Group. He then showed the Disinfestation film " The Challenge ", and a ten-minute film on the Felcourt Research Laboratories, giving a spoken commentary on the latter. This was then followed by a fifteen minute discussion.

Warble control

The use of systemic insecticides for the control of warble fly into cattle began last autumn on a commercial farm scale and some of the results of such treatment are now available.

The first of these reports comes from the Institute of Agriculture, Askham Bryan, where in November 1959, the Principal Mr. L. C. G. Gilling dosed 21 home-bred Friesian steers, keeping 20 similar beasts untreated for control purposes. Treatment consisted of applying Etrolene (*0*, 0-dimethyl *0*-2, 4, 5-trichlorophenyl phosphorothioate) orally (as a drench) at a rate according to the live weight of the animal.

A warble count made earlier this year, 1960, revealed that no warbles were visible at all on the treated animals, whereas on the control group as many as 16 warbles were counted on one animal. The hides of the treated animals were undamaged and dressing with derris was held to be unnecessary.

A significant weight gain was also recorded for the treated animals as can be seen in the following table. The cost of treatment was between 5 to 10 shillings per beast.

In another trial Mr. J. W. Frater, director of the Fatstock Marketing Corporation, dosed 24 Friesian crossbreds, mostly at the two teeth or calf teeth stage, with Etrolene, 28 cattle were left untreated. At the 1960 warble count the 24 treated cattle were 92% clear of warbles while 98% of the untreated animals were warbled, some quite heavy.

The percentage of treated animals free from infestation may have been higher but a conservative estimate had to be made due to the fact that several animals lost their ear tags.

Weight gains were again recorded, the treated cattle averaging 8 cwts. 3 quarters at sale compared with 8 cwts. 2 quarters of the untreated beasts.

Noteworthy control of a heavy infestation was recorded in another Scottish experiment where ten Aberdeen Angus stock bulls varying from 3-7 years of age were dosed with Etrolene at the end of last November. With the exception of one six year old bull, which it is believed did not receive a full dose, all bulls were clean of warbles in 1960, although in the Spring of 1959 the average infestation per beast was 73 warbles.

The general evidence of weight gains from a number of independant trials appears to indicate that the extra value of the carcass at slaughter may more than compensate for the cost of treatment.

Thieves of stored grain take 75,000,000 tons each year

World production of cereal grains in 1956, excluding the USSR was 756,000,000 metric tons, of which at least 10 per cent. was destroyed by insects, rodents and fungi, a loss of 75,600,000 tons. At an average ration of 800 grammes daily per person, this would have fed 255,000,000 people for a year.

In a world where millions still go hungry, the reduction of such food losses could play a significant part in the struggle to increase world food supplies. Today, effective action can be taken against rats, insects, and fungi, and is one of the cheapest and quickest means of increasing the amount of food.

Most farmers know the high cost of rats. In the United States of America, it has been estimated that each rat feeding on stored grain costs the famer $6 a year. But many farmers, shipping and agricultural merchants do not realise how heavy are grain losses resulting from insect infestation. They think that a few insects in their granaries and warehouses are not worth bothering about. But that depends on the kind of insect. It may not multiply in large numbers at home but when shipped abroad with the grain it may breed prodigiously and infest great quantities of clean grain.

The First World War provided a striking example of losses that can occur. From 1917 to 1919, the United Kingdom had 3½ million tons of grain stored in bags in Australia, which could not be delivered because of German U-boat activity. It was attacked by weevils and damage to the extent of $2½ million was done before control measures were started. Control cost $1½ million, making the total loss $4 million, the largest in history in any one stockpile. It could have been prevented.

Infestation may take place while the grain is growing in the field, as soon as it is stored in farm warehouses or any other time as it is moved by road, rail, barges and ships, or kept in mills, silos, grain elevators, etc.

The great centres of infestation are the world ports where there are countless opportunities for infestation while grain is being transferred, stored in transit sheds, put in sacks that have not been properly cleaned, or undergoing treatment in the flour mills.

Fantastic tales are told of the damage caused by weevils when grain was carried in sailing vessels. From one shipment of 145 tons of American maize sent to England in 1868, one and three-quarter tons of weevils were screened out during the following year, an estimated weevil population of over four thousand million.

With fast ships and better methods of handling, risks of insect losses are not so great. Rodenticides, insecticides and fungicides are now available to attack the pests. But in many areas, personnel, organization and facilities for the prevention of losses are inadequate. The most critical areas at present are the humid tropics such as South-East Asia, the Near and Middle East and Africa, where pests breed rapidly and storage facilities are insufficient.

To prevent infestation, careful precautions must be taken and tests made regularly. This is possible in countries where grain is grown on large mechanized farms, provided with modern handling and storage equipment. But in countries where the grain comes from small farms, storage space is often inadequate, the

farmers lack the necessary technical knowledge and preventive methods are more difficult.

Even with modern methods of control, storage and handling, no country can wage an effective total war on the pests if its neighbouring or trading countries do nothing. The attack must be international because an infestation can be carried thousands of miles from one region to another.

In launching the Freedom from Hunger Campaign, FAO has placed special emphasis on both international control measures and national action projects to prevent losses in stored grain. Projects involved design, construction and demonstration of improved and inexpensive farm storage facilities, and development of effective methods of pest control in farm stored grain. Efforts will also be made to train local personnel, to develop pest control techniques and evolve methods for drying grains in community storage centres.

Appointment in Yorkshire

Mr. V. Cory, B.Sc., at present Deputy County Advisory Officer in the National Agricultural Advisory Service, Essex, has been selected as County Advisory Officer for Yorkshire (West Riding) in succession to Mr. J. Gibbons, M.Sc., who has been appointed County Advisory Officer for Somerset.

Mr. Cory took up his new post on 3rd October, 1960.

Extraction and determination of Pesticides

Pages 697 to 742 of the *Journal of the Association of Official Agricultural Chemists* **43** (3) August 1960, deals with extraction and determination of various pesticides. Papers include :—

(1) A Comparison of Procedures for the Extraction of Parathion from Leafy Vegetables.
(2) Determination of DDT in Leafy Vegetables.
(3) The Infrared Spectra of Organic Phosphate Pesticides and their Application to Some Problems in Phosphate Pesticide Analysis.
(4) Paper Chromatography of Ferbam, Maneb, Nabam, Thiram Zineb and Ziram.
(5) Quantative Paper Chromatography of Chlorinated Insecticides in Soils.
(6) Identification of Pesticide Residues in Extracts of Fruit, Vegetables and Animal Fats III Metabolites of Chlorinated Hydrocarbon Pesticides in Animal Depot Fat.
(7) Residues in the Milk of Cows Orally Administered a Mixture of Heptachlor and Heptachlor Epoxide.
(8) Two Modifications of the Colorimetric Procedure to the Determination of Serum Chlorinesterase. Application to Trithion and Phosdrin.

and,

(9) The Inhibition of Human Plasma Cholinesterase by Sevin, Parathion, Phosdrin, Trithion an Systox.

Whoa !

The importation of horses, asses and mules which have passed through or come from Africa, Cyprus, and a group of Asian countries was prohibited from 27th September. This is the effect of the Importation of Horses, Asses and Mules (African Horse Sickness) (Prohibition) Order, 1960, made by the Minister of Agriculture, Fisheries and Food and the Secretary of State for Scotland. The ban affects Africa, Afghanistan, Cyprus, India, Israel, Iraq, Iran, Jordan, the Lebanon, Pakistan, Saudi Arabia, Turkey, United Arab Republic and the U.S.S.R.

Although the total number of horses imported from the countries affected by the present epidemic of African horse sickness rarely reaches double figures in any one year, no avoidable risk can be taken of the disease reaching Great Britain. It is endemic in parts of Africa, and since October, 1959, has spread to a number of near and middle eastern countries.

African horse sickness is carried by insect vectors. It is a deadly disease. Morbidity and mortality rates often approach 100%. Nearly all horses bitten by the virus-carrying insects fall sick, and nearly all those which sicken eventually die. The virus involved in the present series of outbreaks is not exactly the same as any of the seven types known in Africa, and there is no certainty that the vaccine which has been found reasonably effective in Africa would induce the necessary resistance against the Asian strain.

There is already legislation in force which requires horses, asses and mules imported into Great Britain (except from Northern Ireland, the Republic of Ireland, the Channel Islands and the Isle of Man) to be accompanied by various certificates of health given by the State veterinary surgeons of the exporting country. As an additional safeguard (where imports are still permitted), these certificates will now be required specifically to state that the horses referred to showed no symptoms of African horse sickness, and have not been exposed to the risk of infection.

Griffin & George open new headquarters

The Griffin & George group of companies, recently opened a new Scottish Warehouse Sales, Servicing Centre and Offices at Braeview Place, Nerston, East Kilbride. The new premises cover 14,000 square feet, and were built in ten months at a cost of £50,000.

The Griffin & George group claim to be the largest supplier and manufacturer of laboratory equipment in Europe selling their products to educational establishments, research and development organisations, and industrial laboratories all over the world, yet originally the firm began as an offshoot of a publishing company 134 years ago when a book, written by John Joseph Griffin, describing experiments seen at Anderson's University, Glasgow, created such a demand for the instruments mentioned that Griffin's Chemical Museum was founded in order to satisfy it.

Some hundred years later in 1926 the firm which had become known as John J. Griffin & Sons merged with another business to become Griffin & Tatlock Ltd. In 1944 the laboratory supply firm founded in Birmingham in 1906, by Stanley Belcher and Edward Mason, was incorporated into Griffin & Tatlock.

The organisation became known as George & Griffin in 1954 when the expanded requirements of modern industry and education led to a merger with George & Becker Ltd. In 1958 under the chairmanship of Mr. K. G. Sinclair, the company was re-organised on a group structure, which was joined in 1960 by R. & J. Beck Ltd., manufacturers of microscopes and other types of optical instruments.

Maleic Hydrazide affects aphids

Maleic hydrazide, normally used as a plant growth regulator, has been found to affect aphids feeding on plants treated with it, according to A. G. Robinson writing in Canadian Entomology. When bean plants took up a solution of maleic hydrazide through their roots a high proportion of the nymphal aphids feeding on the plants died and adults produced fewer young. But spraying the adult aphids with maleic hydrazide had no effect nor did feeding them on plants dipped in the chemical.

It seems that absorption through the roots may allow a higher concentration of maleic hydrazide to build up than uptake through the leaves, but exactly how it exerts this effect on the insects is not yet clear. Further work is to be done.

Masking agents for Malathion

The laboratories of Dodge & Olcott Inc., 180, Varick Street, New York 14, U.S.A., have developed a new line of odorants especially designed to improve the odour of malathion in a variety of end products including flea sprays and powders, aerosols and sprays.

Interested manufacturers of malathion products are invited to submit samples of their material which will be treated and then returned in a rescented condition, for customary evaluation without obligation.

New laboratory balance

It is stated that the Research and Development of Griffin & George Ltd. have been successful in overcoming the obstacles to the provision of first-class balances at reasonable cost. The result is the 'Duorider' balance in which certain analytical balance characteristics are linked with those of the conventional type of student's balance, to produce a reliable, easy to use accurate instrument.

The new balance has a shortened beam for easier weighing, combined with a single limb bow eliminating impendance, an inclined pointer scale rising with pointer to facilitate reading and reduce parallax, fully relieved agate knives, an easily and rapidly positioned pillar, a rider bar which because it holds 2 captive riders of 1.0 gramme and 0.1 gramme eliminates fractional weights, and chemically stable, non-magnetic, easily cleaned stainless steel pans.

Capacity is 250 grammes, the pointer is white against black engraved plastic scale, the beam is of solid-type, 8 inches long, brass, the sensivity is to 2 mg., the finish is plating or hammer-finish for all metal parts except pans and rider bar, and the base is of moulded plastic.

Price, ex works in the United kingdom : £8 17s. 6d.

Woodworm insurance scheme

The Gallwey Protim Service, Marlow, Bucks, are to operate an insurance scheme whereby house owners can insure the roofs of their houses against woodworm attack and damage.

In these initial stages the insurance scheme only applies to the roofs of dwelling houses in the home counties though possibly in the future structures which are accessible for inspection (e.g. stairs) may also be included. Other areas of the U.K. may also be included if the scheme proves a success.

Briefly the working of the scheme is as follows :—

(a) A very careful initial survey is carried out by the company's surveyor.

(b) If the roof is passed, i.e., no observable trace of infestation, the insurance scheme comes into force immediately on payment of the premium and continues for 9 years.

(c) If the roof is infested and cannot be passed there are two courses open. (i) With heavy infestation, the insurance scheme cannot be applied but the company will carry out thorough treatment of the *whole* roof and issue the owner with a guarantee. (ii) with minor infestation Gallwey will treat the *infested area only*, (this represents a saving over the guarantee scheme in which the whole roof has to be treated) after which the insurance scheme can commence.

(d) Periodic inspections (at least once every two years) are carried out by the company, and—

(e) Should an attack of woodworm develop during the period of insurance it is immediately eradicated by Gallwey at no charge whatsoever.

The cost to the customer not including the fee for the treatment of minor infestation already present is as follows.

Fee for Surveyor's services, report and recommendations, £1 11s. 6d. Annual premiums range from £1 15s. 0d. p.a. for a roof area of 45 sq. yds. to £2 2s. 0d. p.a. for roof areas of 75 sq. yds., which as the insurance lasts for a minimum of 9 years (8 years after the initial year) entails a total cost between £13 15s. 0d. and £18 18s. 0d. for the areas quoted. If the customer leaves his house and cannot persuade the new owner to take over the policy then he must pay the annual premiums to the expiry of the minimum (9 year) period.

For this sum the owner is assured that if due to woodworm his roof caves in the cost of replacement will be covered by Gallwey up to £10,000 in any one year. If anyone happens to be under the roof at the time of collapse then a sum up to £25,000 is payable for damage caused to person or property.

Protecting logs

Preservation Developments Ltd., 23, Sloane Street, London, W.1., have produced two new products, Hexaplus and Protoplus, for the protection of freshly felled logs against ambrosia and bark beetles. The active ingredient of both products is *gamma* BHC and in addition Protoplus contains a chlorinated phenolic fungicide to prevent infection by fungi causing sapstain and dote.

The products possess the unique advantage of being miscible with either oil or water. Thus in the dry season when logs are transported by rail or road, these concentrated pesticides can be diluted with water, whilst in the wet season when the logs are floated down-stream, etc., a diluent such as diesel oil, kerosene or tractor vapourising oil can be used.

F.P.R.L. Steering Committee appointment

Professor M. V. Laurie, O.B.E., M.A., who holds the chair of Forestry at Oxford University, has been appointed a member of the Steering Committee of the D.S.I.R.'s Forest Products Research Laboratory at Princes Risborough. He succeeds Mr. Harry Douglass, General Secretary of the Iron and Steel Confederation. The appontment is for a period of two years.

NEW PUBLICATIONS

Plant Nematodes—Their Bionomics and Control

by J. R. Christie.
Published by The Agricultural Experiment Stations, University of Florida, Gainsville, Florida.

This book is one of the most excellently produced publications that we have received for some time. The book is intended as an introductory textbook and reference for students of plant nematology. Thanks to Dr. Christie's clear and concise style of writing which enables anyone with a modest knowledge of biology and agriculture to understand the book, the objective has been attained. However, the study of plant nematodes, indeed nematodes in general, as a distinct subject is so comparatively recent that even the most acknowledged expert may consider himself a student in certain respects and taken all round the book could prove useful for both the expert and the farmer.

The author has not made the error, too common with many "introductory" textbooks, of trying to cover in detail every facet of the subject. Ample literature is cited at the end of each chapter for detailed study.

The first chapter deals with nematodes in general; the size, shape, general appearance, life cycles, feeding habits and natural enemies of plant nematodes and symptoms of nematode injury to plants. Chapter two deals with methods of controlling nematodes, giving accounts of the use of heat, crop rotation, and biological control, with the latter including reference to the use of organic matter and mulching and resistant species, e.g., the african marigold (*Tagetes spp*). This chapter also gives an account of the chemical control methods, including notes and discussion on the nematicides used, methods of application and the advantages and disadvantages of soil fumigation. One quote from this section cannot be resisted for in commenting on the claim that some fumigants encourage plant growth apart from controlling nematodes Dr. Christie says—

"So far as plant growth is concerned, it seems doubtful if fumigation exerts much push, it merely takes off the brakes."

The greater extent of the book — chapters 3 to 14 — is taken up with separate accounts of specific groups of nematodes. For example in chapter 3 the author deals with the root-knot nematodes (*Meloidogyne spp*), their life history, feeding habits, factors influencing development, injury to plants, hosts, destruction and control. Chapter 4 concerns the cyst nematodes (*Heterodera spp*), chapter 6 the lesion nematodes, chapter 9 bud and leaf nematodes and so on.

A most useful appendix includes five tables. Table 1 lists a number of common crops, the types of nematode attacking the crop and regions where crop damage is known to occur. Table 2 lists nematodes and the crops they attack and methods of control. Table 3 gives hot water water treatments for denematizing planting stock. Table 4 is a list of common names of plant nematodes with the scientific name, and table 5 is a list of scientific names and synonyms.

The Status and Development of Elm Disease in Britain. Forestry Commission Bulletin No. 33.
By T. R. Pearce, M.A.
Published by H.M.S.O. London, Price 10/-

The reviewer has always had a high regard for the Forestry Commission's publications. In their content they nearly always cover exactly what they intend to do. This publication is no exception to the rule, moreover, the summary and conclusions almost save us the task of writing a review. The bulletin can be recommended to forestry workers and other bodies such as the Parks Departments of local councils.

This bulletin is mainly devoted to describing the surveys, in Britain, of Elm Diseases caused by the fungus *Ceratostomella ulmi*. These were started in 1928, and continued with some interruptions until 1955. To provide the necessary background a brief description of the disease is given, followed by a consideration of its history and distribution with particular reference to Britain. Very short descriptions are given of other diseases of elm, which might be confused with that caused by *Ceratostomella ulmi*. Variability in the fungus and differences in resistance in the host are described, with particular reference to their influence on the general behaviour of the disease. The progress of the disease as disclosed by the surveys is considered in relation to (a) the individual tree, where the phenomenon of recovery is particularly discussed, (b) local populations and (c) the country as a whole. A final section is devoted to methods of control.

It is stated that the disease has declined erratically but continually since 1936-37, the author is convinced, in view of the very frequent recovery of attacked elms, that the policy in Britain of virtual '*laissez faire*' has prevented wide scale losses and it is possible that widespread felling was a mistake in Holland and even in America. For these reasons it is concluded that control should be limited to the removal of elms which are dead, nearly dead or unsightly, since these may act as centres of spread for infected Scolytus beetles which are almost entirely responsible for the spread of the disease. Where possible dead limbs, which serve the same role, should also be removed. Unbarked logs and elm firewood should never be left in the vicinity of living elms. These precautions should lessen the possibility of severe local outbreaks.

Bulletins and Information Sheets

D & O Malamasques. D & O bulletin No. 5. This one page information sheet outlines the uses of "Malamasques" a series of additives designed to mask the characteristic odour of malathion based sprays. Leaflet and further information from Dodge & Olcott Inc., 180, Varick Street, New York 14, U.S.A.